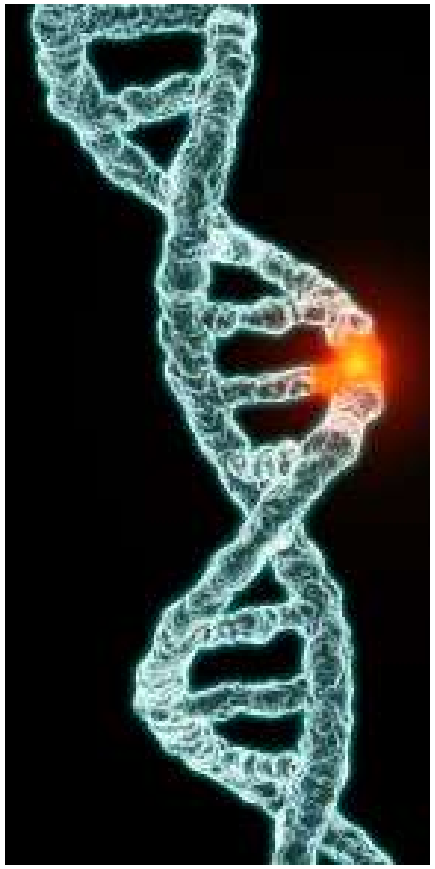
Lesson 8- Mutations



Learning Objectives:

- Define mutation
- Explain the 3 types of mutations
- Determine whether or not a mutation affects a protein
- Explain why some mutations have no affect on an organism

AIM: What are mutations, and do they always affect protein synthesis?

In genetics, a **mutation** is a *change in the base sequence of a gene.* Genes are segments of **DNA** that code for proteins. The specific sequence of DNA bases is transcribed into a single strand of **mRNA**. The mRNA message leaves the nucleus and goes to the **ribosome**, the organelle where proteins are synthesized as amino acids are attached together.

1. What is a mutation?

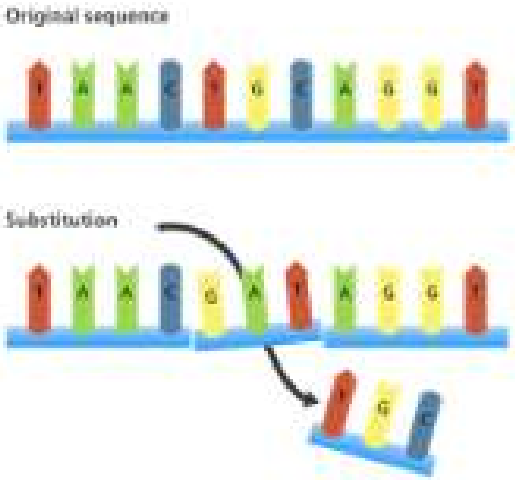
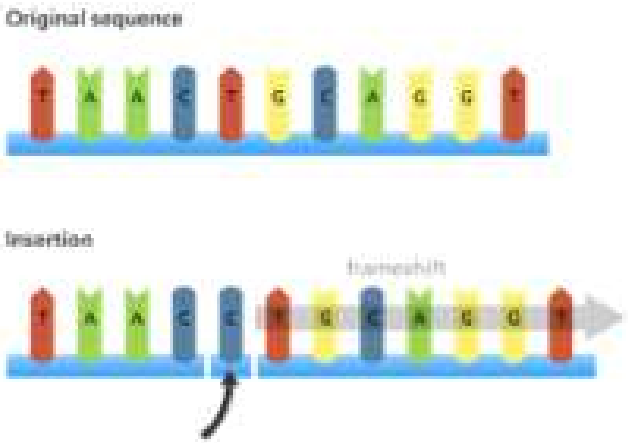
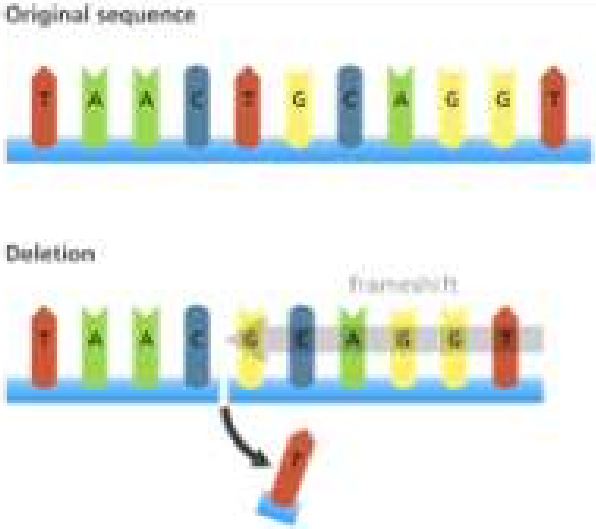
2. Which organelle stores the genetic information for protein synthesis?

3. Which organelle builds the protein?

4. What is the *direct* source of instruction used by the ribosome for making a protein?

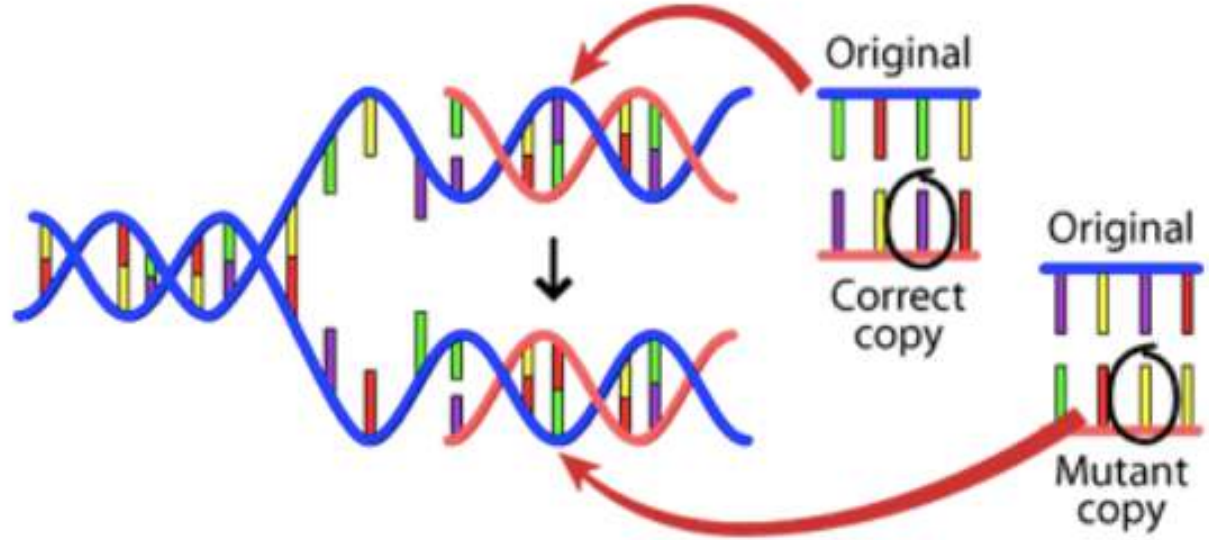
5. What is the *indirect* source of instruction for making a protein?

There are three types of mutations that can occur. An **insertion** is when an extra base, or sequence of bases is **added** to the DNA code. This results in a DNA code that is *longer* than the original sequence. A **deletion** is when a base, or sequence of bases is **removed** from the DNA code. This results in a gene that is *shorter* than the original sequence. A **substitution** is when a base, or group of bases is **replaced** by different letters. This results in a gene sequence of the same length, but with different bases.

		
This mutation is a **substitution**- 3 bases from the original sequence were replaced with different letter. The sequence remains the *same length*. Mutations happen during cell division.	This mutation is an **insertion**. An extra base was accidently added during DNA replication. This makes the sequence *longer* than the original sequence.	This mutation represents a **deletion**. During DNA replication, the "T" was not copied properly. The mutated sequence is *shorter* than the original sequence.

When do mutations take place?

Mutations take place during **DNA replication of cell division**. Don't forget that DNA replication happens prior to cell division (both mitosis and meiosis). If the DNA is NOT copied properly, and there is *any* change from the original sequence, a **mutation** has taken place. Once again, this happens when extra bases are added, bases are deleted, or the wrong base pair is added to the new sequence.



Questions: Do ALL mutations affect the final protein product? How is it possible that a mutation in the DNA has NO effect on the final protein? …

Part 2- *The effects of DNA mutation on protein production:*

- A sequence of DNA from a particular gene is shown below.
- Use the gene to form a single strand of mRNA. Be sure to bracket your codons (every **3** bases) This will help prevent any mistakes while you are coding.
- Then, use a *Universal Genetic Code Chart* to look up the sequence of amino acids in the protein.

ORIGINAL SEQUENCE:

Sequence of DNA in gene: TAC CAA CGA CTC CCG GGA

mRNA _____

Sequence of amino acids _____

Mutation 1: *The '**C**' in the third codon was **deleted** during DNA replication. Notice how the deletion shifted all of your codons (groups of 3) after it took place!! The final "GA" will not code for an amino acid.*

Sequence of DNA in gene: TAC CAA ~~C~~GAC TCC CGG GA

mRNA _____

Sequence of amino acids _____

Did this mutation affect the final protein product? (Did the *sequence of amino acids* change??)

Mutation 2: *Two **substitutions** have taken place! A '**G**' has replaced a '**A**,' and a '**T**' has replaced a '**G**.' These mistakes happened during RNA replication.*

Sequence of DNA in gene: TAC CAG CGA CTC CCT GGA

mRNA _____

Sequence of amino acids _____

Did this mutation affect the final protein product? (Did the *sequence of amino acids* change??)

Conclusion: Not all DNA mutations will affect final protein products. This is because each of the 20 amino acids is coded for by *multiple* mRNA sequences. Mistakes *can* happen during DNA replication, but this helps to protect us against any harmful effects on the final protein. Mutations only affect the final shape of the protein **if they change the amino acid sequence.** Mutation 1 ***did*** change the amino acid sequence. This mostly likely results in a protein *that can no longer function*. Mutation 2 ***did not*** affect the final protein. This means that even with a genetic mutation, the organism is still able to code for a functional protein.

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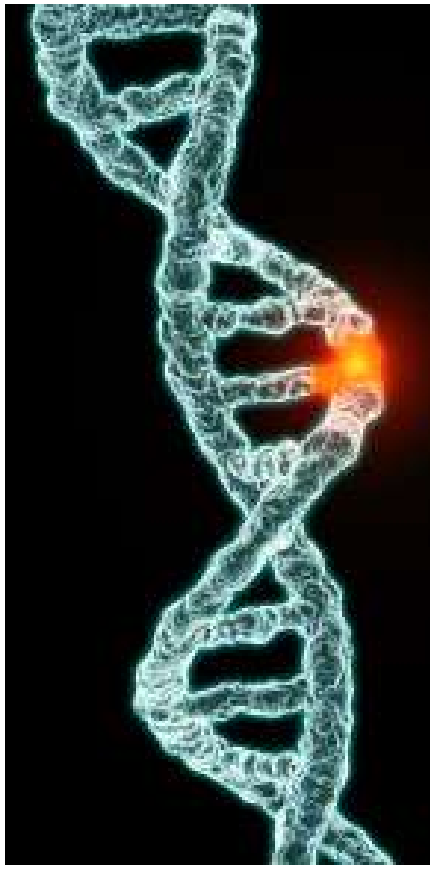

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